INTERFERENCE AND CONTROL OF HOGPOTATO (*HOFFMANSEGGIA GLAUCA*) IN COTTON (*GOSSYPIUM HIRSUTUM*)

By

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(HOFFMANSEGGIA GLAUCA) IN COTTON

(GOSSYPIUM HIRSUTUM)

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INTRODUCTION

Each part of this thesis is a separate manuscript to be submitted for publication in Weed Science, the journal of the Weed Science Society of America. Articles in that journal are peer reviewed and must report experiments repeated over time and/or space. Because of the latter requirement, some preliminary data previously collected by Neil M. Hackett were included in the first part of the thesis. The 1986 data in that part were collected by this author as were all data in the second part.

PART I

INTERFERENCE OF HOGPOTATO (*HOFFMANSEGGIA GLAUCA*) IN COTTON (*GOSSYPIUM HIRSUTUM*)

Interference of Hogpotato (*Hoffmanseggia glauca*) in Cotton (*Gossypium hirsutum*)

Abstract. The effects of hogpotato interference on cotton lint yield and fiber quality were measured under field conditions. Lint yield reductions ranged from 42 to 99% following full-season weed interference. Interference during the first 7 weeks of crop growth reduced lint yields by 41%. Interference which began after 7 weeks of weed-free maintenance resulted in a lint yield reduction of only 5%. Full-season hogpotato interference significantly reduced cotton height. Weed dry weight was significantly reduced by full-season competition with cotton. Cotton fiber quality was measured at one location and was affected in 1 of 2 years. Volumetric soil moisture readings indicated significant extraction of soil water by hogpotato at depths of 122 cm and deeper in the soil profile while treatments with cotton were extracting the majority of soil water in the upper 46 cm of the profile. Nomenclature: hogpotato, *Hoffmanseggia glauca* (Ortega)Eifert #[1] HOFDE; cotton,

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[1]Letters following this symbol are a WSSA-approved computer code from Composite List of Weeds, Weed Sci. 32, Suppl. 2. Available from WSSA, 309 West Clark St., Champaign, IL 61820.

Gossypium *hirsutum* L. 'Paymaster 404' and 'Paymaster 145'. *Additional index words*. Crop height, competition, lint yield, soil moisture, volumetric soil water, *Hoffmanseggia densiflora*, HOFDE.

INTRODUCTION

Hogpotato is a perennial legume native to the southwestern United States and California (19). Other common names for the weed include "pignut", "camote de raton", and "indian rushpea" (1, 12, 23). The semi-prostrate growth of hogpotato seldom exceeds a height of 30 cm. Leaves are bipinnately compound, and yellow flowers are born on erect racemes. Typical legume pods are produced and usually contain seven to eight seed but only three to four of these reach full maturity. Although seed production is low, plants produced from seed quickly establish themselves as perennials in as few as 20 days after emergence (15). Plants produce an extensive underground root system characterized by tuber-like vegetative propagules. Previous research has indicated that these propagules are produced from 15 to 100 cm below the soil surface, and each is capable of producing a new plant (13).

As early as 1935, hogpotato was recognized as a potential weed problem in California (1). The weed was occasionally found in the San Joaquin Valley and was commonly found in the Mohave and Colorado deserts. Hogpotato infestations have also been reported in several areas of Texas (23). Severe infestations occur on several sandy soils in the Rolling Plains area of Texas, and hogpotato occasionally infests fine-textured soils of the Central Panhandle. In Oklahoma, infestations occur more commonly in the southwestern part of the state, i.e., the principal cotton producing area. Infestations normally appear as sharply defined, irregularly shaped, isolated patches which are usually no larger than 1 ha. Within those infestations, substantial yield reductions are commonly observed.

Earlier researchers indicated that hogpotato was commonly found on alkaline soils (1, 17). However, Hackett and Murray (14) tested soil samples collected at three locations with native infestations of hogpotato and at one location in which hogpotato was propagated 2 years prior to sampling. Soil samples were taken in 15-cm increments to a depth of 60 cm. Samples were collected from inside the infestation, around the perimeter of the infestation, and well outside of the infestation. Analyses of the soil samples included measurements of pH, electrical conductivity, total soluble salts, sodium adsorption ratio (SAR), exchangeable sodium percentage (ESP), percent sodium, and concentrations of Na^{+}, Ca^{++}, Mg^{++}, NO_2^{-}, Cl^{-}, SO_4^{-}, and HCO_3^{-}. Results indicated that hogpotato was not limited to alkaline soils nor were any of the other soil characteristic found to be correlated with hogpotato growth.

The effects of weed competition on cotton yields have been well documented for several annual weeds (3, 4, 5, 6, 7, 20, 21); however, data on the competitive ability of perennial weeds have been more limited (2, 10, 16). Earlier research indicated that weeds are more competitive when allowed to germinate and grow simultaneously with the crop. Buchanan and Burns (3) investigated the weed-free requirement and competitiveness of cotton with mixed broadleaf and grass weed species. Maximum yield was obtained when cotton was maintained weed-free for the first 8 weeks after emergence. Keely and Thullen (16) found that full-season yellow nutsedge, Cyperus esculentus L. # CYPES, competition resulted in seed cotton yield reductions of 34% while interference for 6 to 8 weeks resulted in a 20% reduction.

Competition for water and nutrients occurs long before plants begin to shade each other. According to Pavlychenko (18) competition begins when weed and crop root systems overlap in their exploration of the soil profile. Results from experiments with common cocklebur, Xanthium strumarium L. # XANST, and soybean, Glycine max (L.) Merr., indicate that common cocklebur roots are able to exploit a greater volume of soil than can soybean, thus giving the weed a competitive advantage over the crop (9). In the cotton producing areas of Oklahoma, water is commonly a limiting factor for crop growth. Thus, the availability of soil water and relative utilization by the crop and weed are very important.

Limited research has been reported on the effects of hogpotato interference on the growth and development of cotton. Although hogpotato is not currently considered a major weed problem, it does produce an extensive reproductive root system thought to be very competitive with cotton; and the weed is difficult to control. The objectives of this research were to evaluate the effects of hogpotato interference on cotton plant height, weed dry weight, lint yield, selected lint yield components and fiber qualities as well as to evaluate hogpotato as a competitor for soil water.

MATERIALS AND METHODS

Duration. Experiments were conducted in southwest Oklahoma near Altus on a Tillman Hollister clay loam (Typic Paleustoll) from 1984 to 1986. Paymaster 404 and Paymaster 145, both stripper-harvested cotton cultivars, were planted with a conventional planter in 101-cm rows. Paymaster 404 was planted on June 2, 1984; and Paymaster 145 was planted on May 10, 1985, and May 29, 1986. The cotton growing season was 118, 201, and 166 days during 1984, 1985, and 1986, respectively. Soil fertility was adjusted annually according to extension soil test recommendations and included 45 kg/ha N applied as ammonium nitrate in 1984. No fertilizer was applied in 1985 or 1986. Cotton was planted in an area which had a natural infestation of hogpotato of approximately 105 ± 21 plants/m^2.

In 1984, treatments consisted of full-season weed-free maintenance vs. full-season weed interference; and the two treatments were arranged in a completely randomized design with four replications. In 1985 and 1986, the experiment was expanded; and a randomized complete block design with four replications was used. In addition to those treatments evaluated in 1984, treatments included weed interference for the first 7 weeks after crop emergence followed by weed-free maintenance for the remainder of the growing season and weed-free maintenance for the first 7 weeks after crop emergence followed by weed interference for the remainder of the season. Those two treatments will be referred to as early-season and late-season weed interference in this paper. Plots were four rows wide by 10 m long in 1984 and four rows wide by 8 m long in 1985 and 1986.

Trifluralin, 2,6-dinitro-N,N-dipropyl-4-(trifluoro-methyl)benzenamine, was applied preplant incorporated at 1.12 kg ai/ha for general weed control during all years. Escape weeds were removed by hand pulling within the crop row and by hoeing between rows. Furrow irrigation was applied as judged necessary throughout the growing season. In 1984, six irrigations supplied a total of 30 to 35 cm of water. In 1985 and 1986, environmental conditions were more conductive for cotton establishment and growth; and in those years, the experimental area received two irrigations each year, which supplied a total of 20 to 23 cm of water.

Insecticide applications were made according to recommendations by Oklahoma State University extension entomology field scouts. Two applications of chlordimeform, N'-(4-chloro-o-tolyl)-N,N-dimethylformamidine, and fenvalerate, cyano(3-phenoxyphenyl)methyl-4-chloro-alpha-(1-methylethyl)benzeneacetate, were made in 1984 for control of the cotton bollworm, Heliothis zea (Bodddie), tobacco budworm, Heliothis virescens (F.) complex and boll weevil, Anthonomus grandis Boheman. In 1986, one application of dicrotophos, dimethylphosphate of 3-hydroxy-N,N-dimethyl-cis-crotonamide, was made for the control of flower thrip, Frankliniella tritici (Fitch) and one application of tank-mixed fenvalerate, chlordimeform, and thiodicarb, dimethyl N,N'[thiobis[(methylimino)carbonyloxy]]bis[ethanimidothioate], was made to control of the tobacco budworm. Insecticide applications were not required in 1985.

Cotton plant height (from the soil surface to the main stem terminal) was measured on six, randomly selected plants/plot. For each year, those measurements were made on 4 dates beginning with cotton flowering and continuing through boll maturity. Prior to weed senescence each year, weed weights were obtained by using 4, randomly placed, 0.25 m quadrats/plot in which all above-ground hogpotato biomass was harvested. Those samples were oven dried at 40 C for 72 and weights were converted to kg/ha. Hand harvest of the two center rows of each plot was initiated on December 1, 19, and 11 in 1984, 1985, and 1986, respectively. Prior cotton harvest each year, one mature boll/plant was sampled from the center portion of 15 randomly selected plants in the to-be-harvested rows of each plot. Those samples were later hand ginned and used to estimate three cotton yield components, i.e., cotton boll size (g seed cotton/boll), picked lint percent [(wt. lint/wt. seed cotton) x 100], and pulled lint percent [(wt. lint/wt. seed cotton plus bur) x 100]. Using the estimate of pulled lint percent, snapped cotton yield from each plot was converted to lint yield and expressed in kg/ha. In 1984 and 1985, measurements of fiber length, length uniformity, micronaire, and strength were also made from these lint samples. Fiber length was measured on a digital fibrograph as 2.5 and 50% span lengths in inches (converted to mm). Uniformity index is a ratio calculated by dividing the 50% span length by the 2.5% span length and expressing the ratio as a percentage. Fiber strength was measured on a stelometer in grams force/tex (gf/tex) and converted into kilonewtons meter/kg (k Nm/ kg). Micronaire was measured in standard units on a micronaire instrument. All quality analyses on cotton fiber were conducted by personnel in the Oklahoma State University Cotton Quality Research Laboratory.

Soil moisture. In 1986, an experiment was conducted on a Kirkland Silt Loam (Ulderic Paleustoll) at the Agronomy Research Station near Stillwater, Oklahoma. Paymaster 145 was planted on June 11, 1986 in 91-cm rows with a conventional planter. Cotton was planted into an established hogpotato infestation which had a density of approximately 129 ± 21 plants/m^2. Soil fertility was adjusted according to extension soil test recommendations and included 45 kg/ha N which was applied as ammonium nitrate using a broadcast spreader. Four row wide by 5 m long plots were arranged in a randomized complete block design with four replications. A single preemergence application of a tank mixture containing 1.68 kg/ha of metolachlor, 2-chloro-N-(2-ethyl-6-methylphenyl)- N-(2-methoxy-1-methylethyl)-acetamide, and 1.68 kg/ha of prometryn, 2,4-bis(isopropyl-amino)-6-(methylthio)-s-triazine, was made on June 11, 1986 for the control of annual weeds. Irrigation was applied with an overhead sprinkler system on July 29, 1986 to supplement rainfall (Figure 1). Treatments evaluated were: cotton with hogpotato interference, cotton alone, hogpotato alone, and bare soil.

Cotton boll numbers (bolls in which seed cotton was visible) were recorded and plots were hand-harvested twice in order to evaluate the effect of hogpotato on cotton maturity. Data for these parameters were collected from 4 m of each of the two center rows of each four row plot. The first harvest was made on October 17, 1986 at an estimated 50% boll opening and a final harvest was made on December 5, 1986 following killing freeze. At each cotton harvest date, one mature boll/plant was removed from the center of 15 randomly selected plants in the two center rows of each plot for lint percentage determinations, a procedure described earlier. Above-ground hogpotato biomass was harvested from the center (0.9 m by 4.0 m) of each plot prior to senescence on October 14, 1986, oven dried at 40 C for 72 hours and weights converted to kg/ha. All yield data were subjected to analysis of variance and comparisons between means were made using the protected LSD test at the 5% level of probability.

Soil water content was measured weekly beginning on June 30,1986 (approximately 2 weeks after cotton emergence) and continued until September 24, 1986 when cotton began to senesce. Each four row plot contained one centrally located neutron probe access tube (Nominal 3.8 cm EMT thin wall steel tubing[2]). Soil water content measurements were made at depths of 15 to 152 cm at 15.24 cm (converted from inches) increments with a Troxler[3] Model 3333 neutron probe with an Am:Be source. Neutron scattering readings were converted to volumetric water content (Θ) in cm^3 of H_2O/cm^3 of soil and plotted against depth and time of measurement. Neutron readings made at the 15 cm depth were interpreted from a single calibration curve while readings made at the 30 cm depth and greater were interpreted from a separate calibration curve. The neutron probe was assumed to give an average reading of soil moisture content from a spheroid bounded 7.5 cm above and 7.5 cm below the specific point at which the neutron source was positioned. Therefore, total

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[2]Emsco Electric Supply Co., Oklahoma City, OK. 73113.

[3]Troxler Electronics Laboratories, Inc., Research Triangle Park, NC 27709.

water contents (cm of water) were calculated to an actual depth of 159.5 cm. Crop and weed phenological data were also collected at each reading date.

All soil water data were subjected to analysis of variance by depth and time and comparisons between means were made using the protected LSD test at the 0.10 level of probability with the exception of total soil water content when means were also compared at the 0.05 level of probability. Graphs of volumetric water content over time and depth were examined and both weed and crop water uptake principles were applied. Following examination of weekly phenological data, rainfall, and irrigation, the growing season was divided into two periods. An early season period (May 30 to July 28) was distinguished by germination up to the beginning phases of reproduction. A late season period (August 18 to September 24) was also noted and was characterized by floral development and continued through boll maturity. This later period was also proceeded by irrigation and then a heavy rainfall (Figure 1). Data, now separated into early and late season, were then subjected to analysis of variance by date (week) and depth within each growing period and a pooled LSD (0.10 level of probability) was calculated for each depth within each growing period. Total water content data were analyzed as a split unit experiment with crop, weed, crop and weed, or bare soil being the main unit treatments and reading dates being the sub-unit treatments. From this analysis, LSDs (0.05 and

0.10) were calculated for each growing season period. Treatment means also were pooled over all dates with each time period and compared using pooled LSD over all dates within that period.

RESULTS AND DISCUSSION

Duration. Following hogpotato interference for 23, 49, and 61 days after cotton emergence in 1984, 1985, and 1986, respectively, cotton height was significantly reduced (Table 1). Height reductions on these dates ranged from 16% in 1985 to 29% in both 1984 and 1986. When grown free of hogpotato for the first 7 weeks following cotton emergence, cotton height was comparable to that of weed-free cotton with the exception of measurements made on December 19, 1985 when a 10 % reduction in crop height was observed. However, when cotton had to compete with hogpotato for the first 7 weeks after crop emergence, hogpotato caused significant cotton height reduction at all dates with the exception of September 18 and December 11, 1986. Plant height reductions caused by early season interference ranged from 7 to 33% on December 19, 1985 and August 5, 1986, respectively. By harvest each year, cotton heights in the early season interference treatment had recovered to heights statistically equivalent to those in the late season interference treatment.

In 1984, full-season hogpotato interference reduced cotton lint yield by over 99% (Table 2). Above-ground hogpotato dry matter production, measured prior to cotton harvest, amounted to 2810 kg/ha. In the plots with full-season hogpotato interference, cotton growth was severely stunted and bolls were smaller and poorly developed when compared to bolls from weed-free plots (data not shown). In the expanded experiments conducted in 1985 and 1986, full-season hogpotato interference reduced cotton lint yield by 58 and 42% respectively, when compared to cotton having full-season weed-free maintenance. Hogpotato dry matter production in the full-season interference treatment increased by 60% in 1985 and 18% in 1986 when compared to each of the previous years. When cotton was maintained weed-free for the first 7 weeks after crop emergence, cotton lint yields were not significantly different from yields produced by weed-free cotton. However, when allowed to compete with cotton for the first 7 weeks following cotton emergence, hogpotato reduced yields by approximately 40% in both years. In 1986 when measurements of hogpotato dry weight from the early and late season interference treatments were made, there were no significant differences in weed weight but as stated earlier, large differences in cotton lint yield were documented from these same plots.

Results from these experiments indicate that full- as well as early-season hogpotato interference can have detrimental effects on cotton growth, development, and yield (Table 2). The magnitude of yield reductions varied over the 3 years in which the experiments were conducted with

1984 having the most severe yield reductions. The severity of yield loss in 1984 may in part be attributed to the extremely short growing season of only 118 days. Cotton with full-season hogpotato interference appeared to be maturing at a slower rate than that which was maintained weed-free. This slowed growth in combination with a very short growing season could explain the large yield reductions documented in 1984. In 1985 and 1986, the growing seasons were much longer and cotton was able to develop into larger and presumably more competitive plants in treatments both with and without hogpotato interference.

Yield component data on boll samples taken at harvest indicate significant differences in boll size and lint percentages in 1984 and 1985 with no difference evident at the 0.05 level of probability in 1986 (Table 2). In 1984, cotton boll size was reduced by 40% in plots having full-season hogpotato interference. In 1985, full-season hogpotato interference was the only treatment resulting in a significant decrease in boll size when compared to cotton having full-season weed-free maintenance. Pulled lint percentages in 1984 were significantly reduced by full-season hogpotato interference. In 1985, early-season weed interference was the only treatment which resulted in a significant decrease in pulled lint percent when compared to those of weed-free cotton. Picked lint percentages exhibited similar trends as those of pulled lint over all 3 years (data not shown). Both pulled and picked lint percentages are important to cotton producers because they have a direct effect on ginning costs (11).

Fiber property analyses from lint samples taken at harvest indicated significant differences between treatments in 1 of the 2 years in which analyses were done (Table 3). In the short growing season of 1984, full-season hogpotato interference resulted in significant decreases in both the 2.5 and 50% span lengths. Full-season weed interference also caused significant reductions in fiber uniformity as well as micronaire. Full-season hogpotato interference reduced micronaire from 4.4 to 2.6 which would result in a severe price penalty (11). In 1985, a more typical growing season, fiber quality analyses revealed no differences between treatments. These results support earlier reports (5, 7, 20, 21) that cotton fiber quality traits are generally not affected by weed interference. Cotton was not graded in either year because the cotton was hand-harvested and hogpotato were removed prior to cotton harvest.

<u>Soil moisture</u>. In the presence of cotton, hogpotato growth was significantly reduced when compared to the weed growing alone. Full-season hogpotato interference resulted in significant ($P > t = 0.094$) cotton lint yield reductions when compared to cotton yields from plots which were maintained weed-free for the duration of the growing season (Table 4). At the first harvest, full-season hogpotato interference reduced cotton lint yield by 351 kg/ha or 58% when compared to the yield from weed-free cotton. However,

cotton with weed interference had lint yields statistically equivalent to those of weed-free cotton at the second harvest. Total lint yields were reduced 31% by full-season hogpotato interference when compared to weed-free cotton.

Cotton boll size and number were two yield components which were significantly reduced by full-season hogpotato interference (Table 4). Results from the first harvest indicated that hogpotato interference reduced ($P > t = 0.076$) seed cotton/boll by 0.58 g. As shown with lint yield, there were no significant differences in boll size at the second harvest. Total boll numbers were significantly reduced from 42 in the weed-free cotton to 18 in cotton with full-season hogpotato interference. At the second harvest there were no detected differences between the two treatments. Total boll numbers were reduced 27% by full-season hogpotato interference. Pulled and picked (data not shown) lint percentages were unaffected by hogpotato interference.

Results from cotton lint yield and yield component data from the Stillwater location provide evidence that full-season hogpotato interference reduced cotton lint yields by delaying crop maturity. This delay in maturity caused by hogpotato is evident in the significant reductions in cotton lint yield, boll size and boll number observed at the first harvest. At the first harvest , these parameters were all significantly reduced by full-season hogpotato interference. However, at the second harvest, there were no statistical differences between treatments but trends did exist. At the second harvest, cotton lint yield, boll size and boll number were all larger in the cotton with full-season hogpotato interference. This trend suggests that full-season hogpotato interference was delaying cotton growth and development and that cotton in these plots was unable to fully develop prior to the first frost; thus, resulting in the yield reductions observed.

Differences in soil water content between treatments appeared to be developing as early as 2 weeks after cotton emergence (Figure 2A). During the early stages of cotton development (2 to 5 true leaves), treatments with hogpotato showed trends of increased soil water extraction in the upper 15 cm of the soil profile when compared to the cotton alone or the bare soil treatments (Figures 2A and 2B). This apparent increase in water use by hogpotato may a result of the weed having an established root system which could immediately extract water from the soil profile, while during this same time period, cotton plants were in the process of root establishment. As the cotton plants developed in the early season, the amount of soil water extracted increased as well as the depth at which water was extracted. This progressive increase in the depth of extraction by the treatments with cotton coincides with cotton root development as described by Ratliff and Taylor (22). During the early season, water extraction by treatments with cotton showed a gradual increase in the depth of extraction and was apparent to depths of 46 and 61 cm by 5 and 6 weeks after cotton emergence, respectively (Figures 2C, 2D and 2E). Soil water content of treatments with hogpotato exhibited an increase in extraction in the lower portions of the soil profile. Both the cotton with hogpotato and the hogpotato alone treatments appeared to be extracting more soil at depths of 107, 122, and 137 cm as early as 4 weeks after crop emergence (Figure 2C) with water extraction by these treatments being apparent at the 152 cm depth on July 28, 6 weeks after cotton emergence (Figure 2E).

Cotton with full-season hogpotato interference showed the largest soil water extraction in the upper portions of the soil profile when compared to the other treatments (Figures 2C, 2D, and 2E). However, soil water curves for cotton with hogpotato interference and cotton alone were very similar in this part of the soil profile. In addition to water extraction in the upper profile, cotton with hogpotato was also showing trends of increased water use in the lower profile. This water extraction in the lower profile was very similar to that of the hogpotato alone treatment; thus suggesting the influence of the weed on soil water deeper in the profile.

Following irrigation on July 29 and a period of extensive rainfall (Figure 1), treatments with cotton continued to extract water from the upper soil portions of the soil profile (Figure 3). Immediately following the rewetting period, these treatments were extracting significantly more water to a depth of 76 cm than either the hogpotato alone or the bare soil treatments (Figures 3A and 3B), and eventually extracted water to a depth of 91 cm (Figures 3C, 3D, and 3E). Lower in the profile, cotton alone showed less water extraction than the other plant bearing treatments and approached that of the bare soil treatment by the 137 cm depth. Treatments with hogpotato continued to extract water from lower in the soil profile (>107 cm). As the season progressed, water extraction by plots with hogpotato began occur at a depth of 122 cm and continued through the 152 cm depth and possibly deeper in the soil profile. As boll development began (September 3), increased use of soil water appeared at depths of 61 and 76 cm in the cotton alone treatment (Figure 3C, 3D, and 3E). Cotton continued to extract water from the upper and middle portions of the soil profile down to a depth of 91 cm while the cotton with hogpotato interference was extracting significant amounts of water from the lower portions of the soil profile.

Analysis of total water in the 152 cm soil profile indicated that trends of early-season water extraction were established as early as 5 weeks after cotton emergence (Figure 12). On June 30 (2 weeks after cotton emergence, all treatments showed approximately equal amounts of water in the 152 cm soil profile. Four weeks after cotton emergence, all plant bearing treatments had significantly less water than the bare soil treatment and treatments with hogpotato appeared to be extracting the larger amounts of soil water. Water use by hogpotato in the early part of the growing season may be the result of the weed having established roots as deep as 1 m (11,12) which were present prior to cotton planting. As the growing season progressed and cotton became established, water extraction by treatments with cotton increased appeared to have the largest amount of water extraction by 6 weeks after cotton emergence. Throughout the early growing season, cotton with hogpotato interference consistently extracted more water from the profile than any of the other three treatments.

Trends in water extraction established in the early season of cotton development continued into the late part of the growing season during a stages of floral initiation and boll development (Figure 4). As seen in the early growing season, there was a general decline in total water as the season progressed. For all dates in the late season period, bare soil had significantly more total soil water than the weed, crop, or crop and weed treatments. Cotton with hogpotato interference appeared to have the largest extraction of soil moisture throughout the late portion of the growing season and extracted significantly more soil water than all other treatments on the last 4 reading dates. Weed-free cotton appeared to extract more water than the hogpotato alone treatment on all reading dates in the late season period.

Since the trends of total water extraction were consistent throughout the late growing season, a statistical analysis was run to test for treatment by time (week) interaction. This interaction was significant, but was extremely small when compared to the treatment effects (treatment $F_{df\ 3,9} = 92.9$ vs treatment * time $F_{df\ 8,48} = 8.9$). Treatment by time interaction was assumed to be nonsignificant from a practical standpoint and treatment means were pooled over time (Table 5). Results indicate that all treatments significantly reduced total soil water in the early part of the growing season when compared to the bare soil treatment. During the early time period, cotton with hogpotato interference appeared to have increased water extraction when compared to the other treatments. In the late period of the growing season, bare soil had the largest amount of soil water with hogpotato alone, cotton alone and cotton with hogpotato interference having decreasing amounts of soil water. Although hogpotato alone showed trends of less soil water extraction than the cotton alone treatment, the weed's effects on soil water were seen in the cotton with hogpotato interference treatment. Cotton with hogpotato interference extracted significantly more soil water than the cotton alone treatment, thus indicating the weed's potential as a competitor for soil water.

Hogpotato is very competitive when allowed to emerge and grow simultaneously with cotton. As seen with other weeds, the majority of yield reductions occur when the weed is allowed to compete in the earlier portion of the growing season (3). Both full-season hogpotato interference and interference for the first 7 weeks after crop emergence resulted in significant cotton lint yield reductions. Cotton plant height was reduced by full-season hogpotato interference; however, this reduction posed no problems in the harvesting of cotton. Hogpotato delays cotton maturity which can result in additional yield reductions in years with short growing seasons. Cotton fiber properties are also subject to decline when extremely short growing seasons are experienced. Cotton is very competitive with hogpotato and significantly reduces weed biomass when allowed to compete for the entire growing season. Cotton extracted the largest amounts of soil water in the upper portion of the soil profile while hogpotato extracted water from lower in the profile. Although hogpotato was shown to extract significant amounts of soil water from the lower soil profile, competition between the weed and the crop for soil water does not appear intense enough to account for the large yield reductions which have been documented.

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Table 1. Cotton plant height as affected by hogpotato interference in 1984, 1985, and 1986 near Altus, OK[a].

	1984				1985				1986			
Treatment	7/6	7/23	8/15	11/3	7/5	7/30	8/21	12/19	8/5	8/20	9/18	12/11
	(cm)											
Weed-free full-season	14a	35a	61a	77a	25a	51a	57a	61a	49a	62a	82ab	84a
Weed-free 7 wks then weedy	-	-	-	-	25a	48a	56a	55b	46a	62a	86a	84a
Weed inter. 7 wks then weed-free	-	-	-	-	21b	34b	51b	57b	33b	52b	77bc	78ab
Weed inter. full-season	10b	18b	29b	43b	21b	29c	33c	39c	35b	46c	74c	72b

[a]Within each column, values followed by the same letter are not significantly different at the 5% level according to protected LSD test.

Table 2. Effect of hogpotato interference on weed weight, cotton lint yield and lint yield components in 1984, 1985, and 1986 near Altus, OK[a].

							Cotton yield components by year					
	Hogpotato dry weight			Lint yield			Boll size			Pulled lint		
Treatment	1984	1985	1986	1984	1985	1986	1984	1985	1986	1984	1985	1986
	(kg/ha)						(g seed cotton/boll)			(%)		
Weed free full season	---	---	---	480a	640a	870a	5.1a	5.0a	5.1a	27.7a	30.7a	25.9a
Weed-free 7wks 7 wks.	---	1670b	1090b	---	610a	760a	--	4.8ab	5.3a	---	30.7a	25.8a
Weed inter. 7 wks.	---	---	1320b	---	380b	530b	--	4.4ab	5.3a	---	28.8b	25.1a
Weed inter. full season	2812	4709a	5568a	10b	270b	510b	3.1b	4.1b	5.4a	21.4b	30.4a	24.8a

[a]Within each column, values followed by the same letter are not significantly different at the 5% level according to protected LSD test.

Table 3. Cotton fiber properties as affected by hogpotato interference in 1984 and 1985 near Altus, OK[a].

Treatment	Span length 2.5% 1984	Span length 2.5% 1985	Span length 50% 1984	Span length 50% 1985	Uniformity index 1984	Uniformity index 1985	Micronaire 1984	Micronaire 1985	Strength 1984	Strength 1985
	(mm)				(ratio)		(units)		(kN m/kg)	
Weed-free full season	28.0a	25.1a	13.5a	12.2a	48.2a	48.6a	4.4a	4.8a	205a	199a
Weed-free 7 wks then weedy	---	25.4a	---	12.7a	---	50.0a	---	4.8a	---	201a
Weed inter. 7 wks then weed-free	---	25.4a	---	12.2a	---	48.0a	---	4.5a	---	200a
Weed inter. full season	25.4b	25.1a	11.4b	11.9a	45.0b	47.4a	2.6b	4.7a	201a	200a

[a]Within each column, values followed by the same letter are not significantly different at the 5% level according to protected LSD test.

Table 4. Effect of hogpotato interference on weed weight, cotton lint yield and yield components in 1986 at Stillwater, OK[a].

					Yield components by harvest date						
		Lint yield			Boll size		Boll number			Pulled lint	
Treatment	Hogpotato dry weight	First harvest	Second harvest	Total harvest[b]	First harvest[c]	Second harvest	First harvest	Second harvest	Total harvest[d]	First harvest	Second harvest
	(kg/ha)				(g seed cotton/boll)		(open bolls/m^2)			(%)	
Weed-free full-season	---	600a	270a	870a	4.5a	3.7a	42a	22a	64a	28.4a	28.2a
Weed inter. full-season	870b	250b	350a	600a	3.9a	3.9a	18b	29a	47a	28.8a	28.4a
Weed alone	1910a	---	---	---	--	--	--	--	--	--	--

[a]Within each column, values followed by the same letter are not significantly different at the 5% level according to protected LSD test.

[b]Means are significantly different at the 9.4% level of probability according to protected LSD test.

[c]Means are significantly different at the 7.6% level of probability according to protected LSD test.

[d]Means are significantly different at the 7.2% level of probability according to protected LSD test.

Table 5. Total water content to a depth of 152cm by growing season period at Stillwater, OK[a] in 1986.

Treatment	Growing season period: Early (5/30 to 7/28)	Late (8/18 to 9/24)
	-------- (cm) --------	
Cotton/hogpotato	42.9a	35.7a
Cotton alone	44.3a	39.1c
Hogpotato alone	44.5a	37.5b
Bare soil	47.1b	46.3d

[a]Within each column, values followed by the same letter are not significantly different at the 5% level of probability according to the protected LSD test.

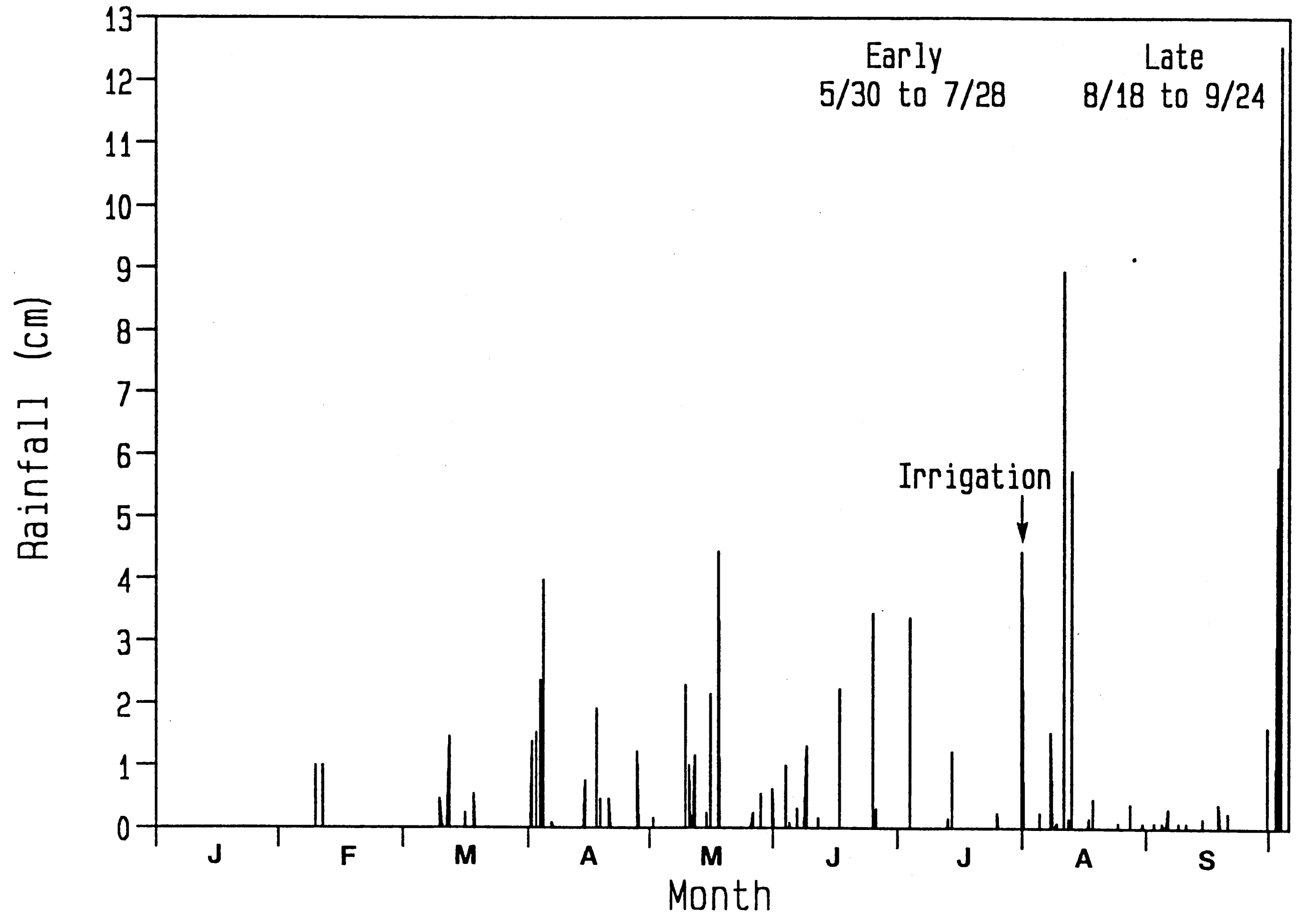

Figure 1. Frequency and amount of rainfall and irrigation at Stillwater, OK in 1986.

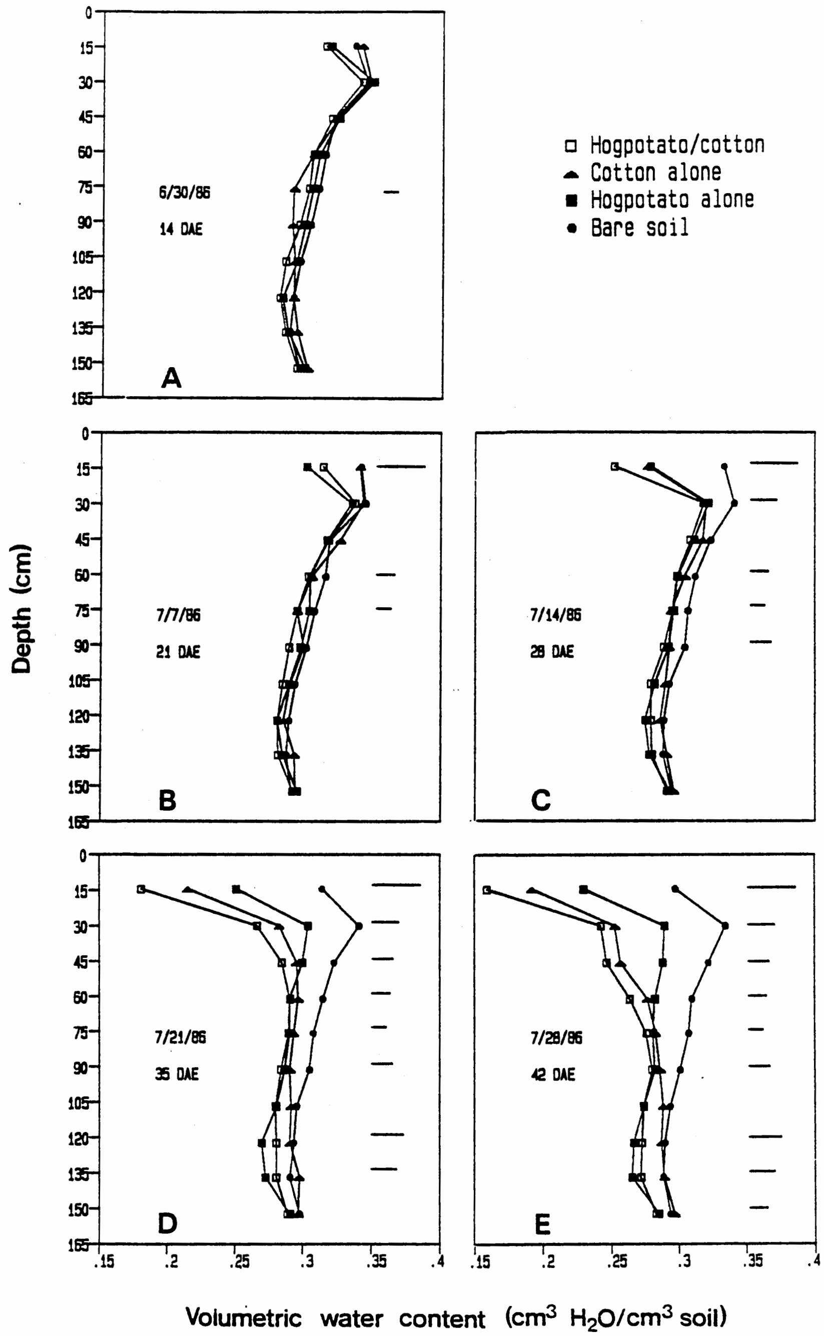

Figure 2. Early season volumetric water content by depth and time (days after cotton emergence, DAE). LSDs (0.10) are presented only at depths where significant treatment differences were detected.

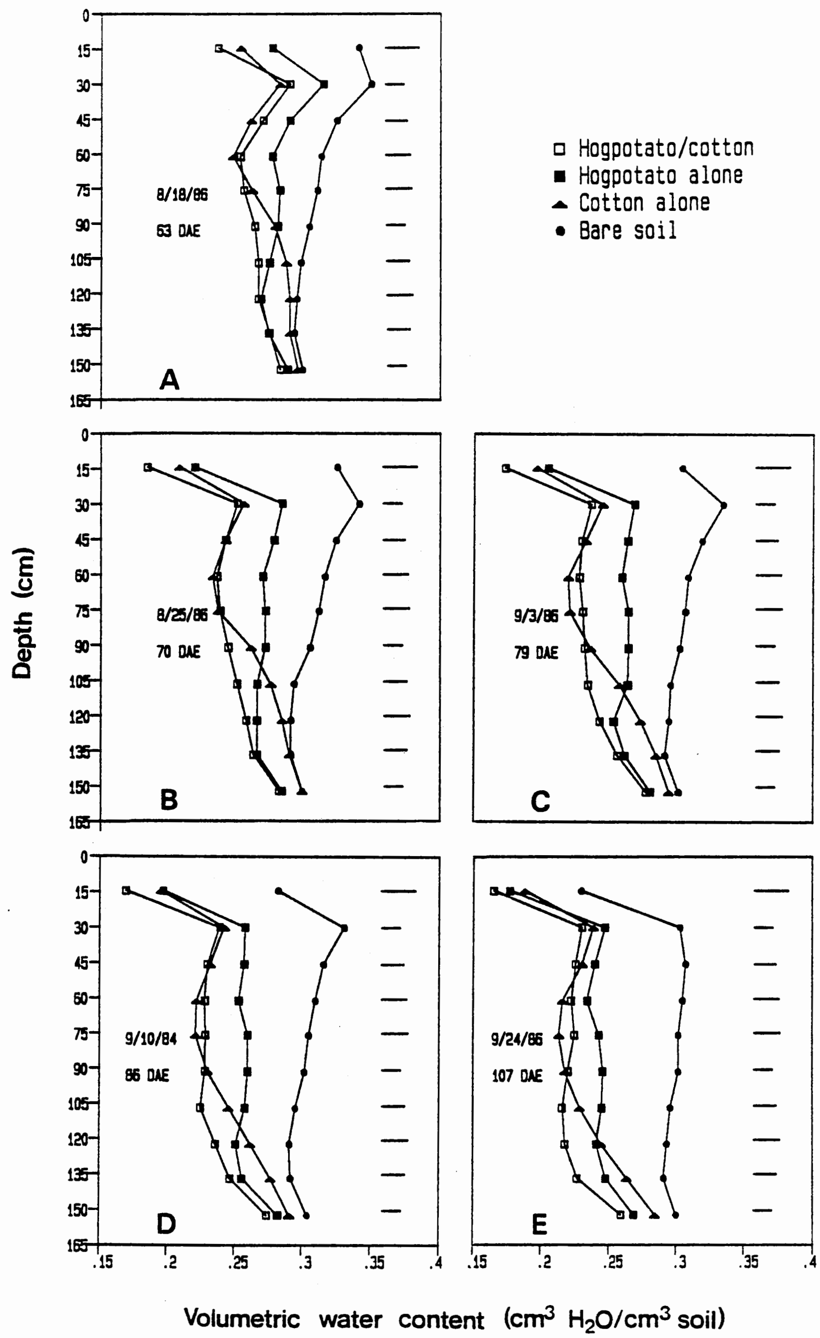

Figure 3. Late season volumetric water content by depth and time (days after cotton emergence, DAE). LSDs (0.10) are presented only at depths where significant treatment differences were detected.

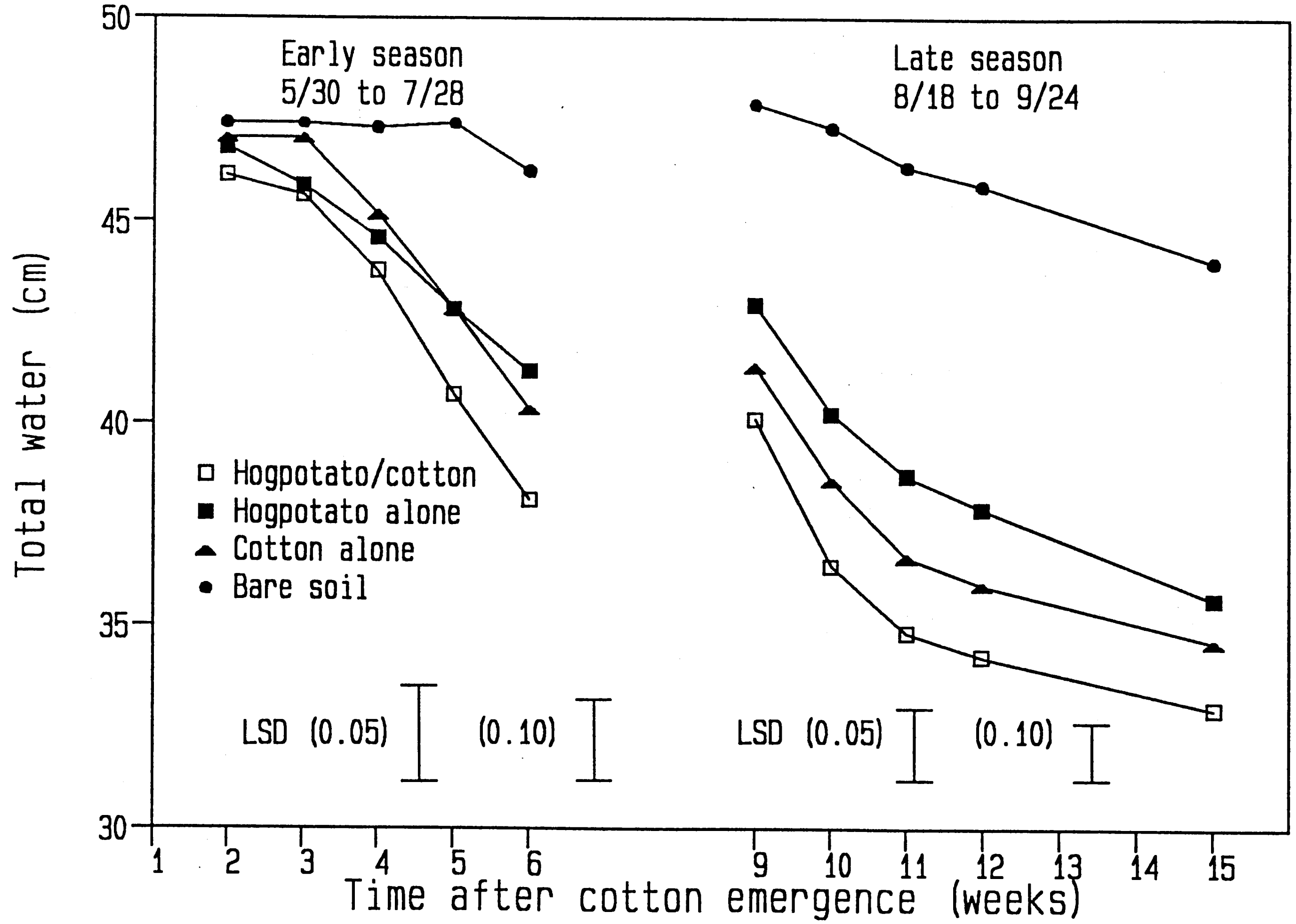

Figure 4. Total water content in the upper 152 cm of the soil profile.

PART II

CONTROL OF HOGPOTATO (*HOFFMANSEGGIA GLAUCA*) WITH POSTEMERGENCE APPLIED HERBICIDES AND SUBSEQUENT ROTATIONAL CROP RESPONSE

Control of Hogpotato (Hoffmanseggia glauca) with Postemergence Applied Herbicides and Subsequent Rotational Crop Response

Abstract. Three field experiments were conducted to evaluate hogpotato control resulting from postemergence applications of five different herbicides. Tryclopyr and imazapyr provided late season hogpotato control as high as 87 and 94%, respectively. Soil bioassays were performed with three indicator species in a laboratory to measure the effects of these herbicides on rotational crops. Both fresh and dry herbage weights of cotton, wheat, and grain sorghum were measured. Tebuthiuron and imazapyr caused the greatest biomass reductions with cotton and wheat being the more sensitive species to these herbicides. Nomenclature: hogpotato, Hoffmanseggia glauca (Ortega)Eifert #[1], cotton, Gossypium hirsutum L., wheat, Triticum aestivum L., grain sorghum, Sorghum bicolor (L.) Moench., tebuthiuron, N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'dimethylurea, imazapyr, (±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-

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[1]Letters following this symbol are a WSSA-approved computer code from Composite List of Weeds, Weed Sci. 32, Suppl. 2. Available from WSSA, 309 West Clark St., Champaign, IL 61820.

oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid

Additional index words. Herbicides, control, soil, residual, bioassay, *Hoffmanseggia densiflora*, HOFDE.

INTRODUCTION

Hogpotato is a perennial legume native to the southwestern United States and California (8). Other common names for hogpotato include "pignut", "camote de raton", and "indian rushpea" (1, 4, 12). The weed produces typical legume pods which usually contain seven to eight seeds; however, only three or four reach full maturity. Although seed production is low, plants produced from seed have been shown to quickly establish themselves as perennials in as few as 20 days after emergence (7). Plants produce an extensive underground root system which is characterized by tuber-like vegetative propagules. Previous research has shown that these propagules are produced from 15 to 100 cm below the soil surface and are capable of producing new plants (5, 6).

Hogpotato was recognized as a potential weed problem in California as early as 1935. Ball and Robbins (1) reported that hogpotato was occasionally found in the San Joaquin Valley and was commonly found in the Mohave and Colorado deserts. Hogpotato infestations have also been reported in several areas of Texas (12). There are severe infestations on sandy soils in the Rolling Plains area of Texas, and hogpotato occasionally infests fine textured soils of the

Central Panhandle. In Oklahoma, hogpotato infestations occur more commonly in the southwestern part of the state which is the main cotton producing area. Infestations normally appear as sharply defined, irregularly shaped, isolated patches usually no larger than 1 ha. Within these infestations, cotton does not develop at a normal rate and substantial yield reductions are commonly observed.

Although the plant is small and seemingly uncompetitive, hogpotato has been shown to cause severe cotton lint yield reductions (2, 3, 5, 6). In Oklahoma, hogpotato interference has been shown to reduce cotton lint yields by 40 to 99%. Within these hogpotato infested areas, cotton plants are often severely stunted and bolls are often small and poorly developed. Research was also conducted to evaluate the weed-free requirement of cotton having hogpotato infestations and results indicate that cotton which was maintained weed-free for the first 7 weeks of the growing season produced approximately equal lint yields as cotton which was maintained weed-free for the entire growing season. Hogpotato which emerged simultaneously with cotton and was allowed to compete with cotton for the first 7 weeks of the growing season, significantly reduced lint yields.

Limited research has been conducted on the control of hogpotato in cropping systems. Earlier researchers evaluated the use of soil sterilants and extremely high rates of selective herbicides. Wiese and Rea (10) evaluated fenac, 2,3,6-trichlorophenylacetic acid, 2,3,6-TBA, 2,3,6-trichlorobenzoic acid, and several polychlorobenzoic acid materials for hogpotato control. They reported that all of these herbicides provided excellent hogpotato control when applied at rates of 22.4 kg ai/ha, 22.4 kg ai/ha, and 44.8 kg ai/ha, respectively. In more recent research, Wiese (12) evaluated 2,4-D, 2,4-dichlorophenoxyacetic acid, 2,4,5-T, 2,4,5-trichlorophenoxyacetic acid, MCPA, [(4-chloro-o-toly)oxy]acetic acid, and 2,3,6-TBA at rates ranging from 1.12 to 4.48 kg ai/ha. Results from early ratings (2 months after application) indicated that all herbicide treatments (except MCPA) provided good control when two applications were made at approximately 10 month intervals. However, one year after the final treatment, 2,3,6-TBA at rates of 2.24 and 4.48 kg ai/ha was the only herbicide which provided acceptable hogpotato control. Several soil sterilants have also been evaluated for the control of hogpotato (11). Good to excellent hogpotato control was reported when monuron, 3-p-(chlorophenyl)-1,1-dimethylureamono(trichloroacetate), or fenuron, 1,1-dimethyl-3-phenylureamono(trichloroacetate), were applied at rates ranging from 44.8 to 89.6 kg ai/ha as well as with sodium chlorate and concentrated borascu at rates of 896 and 3584 kg/ha, respectively. However, as seen with herbicides evaluated in other research, hogpotato control was not acceptable 1 year after application except with sodium chlorate and concentrated borascu.

Although hogpotato is not currently considered a major weed problem, the fact that it is a competitive perennial which is difficult to control indicates a potential serious pest. With this in mind, the objectives of this research were to evaluate several herbicides for control of hogpotato in cotton as well as to predict the effect of these herbicides on subsequent crops.

MATERIALS AND METHODS

Field experiments. Two field studies were conducted in 1987 on a Kirkland silt loam (Uderic Paleustoll) near Stillwater, Oklahoma and one experiment was conducted on a Tillman Hollister clay loam (Typic Paleustoll) in southwest Oklahoma near Altus. At Stillwater, one study was conducted in an area which was propagated with hogpotato in May of 1984 and had a density of approximately 127 ± 20 plants/m^2. The second study at Stillwater was conducted on an area which was propagated with hogpotato in May of 1985 and had a density of approximately 100 ± 15 plants/m^2. At Altus, an experiment was conducted on an area having a natural infestation of hogpotato with a density of approximately 105 ± 20 plants/m^2.

At each location, treatments were arranged in a randomized complete block design with four replications. Plot sizes at Stillwater were 3.7 m wide by 4.6 m long and at Altus were 4.1 m wide by 7.0 m long. With the exception of pelleted formulations, all treatments were applied with a tractor-mounted compressed air sprayer at a constant speed of 6.4 km/hr and a carrier volume of 93.5 l/ha. Pelleted formulations were hand spread. A single application time was used for each experiment. Herbicide treatments at Altus and as well as one experiment at Stillwater consisted of glyphosate, N-(phosphonomethyl)glycine, applied in an ammonium sulfate carrier, imazapyr, and dicamba, 3,6-dichloro-2-methoxybenzoic acid. Application dates for these experiments were June 18, and July 23, 1987 at Altus and Stillwater, respectively. Triclopyr, [(3,5,6-trichloro-2-pyridinyl)oxy] acetic acid, and tebuthiuron were evaluated in the second experiment at Stillwater and were applied on August 6, 1987. Trifluralin, 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine, at 2.12 kg ai/ha was applied as a preplant incorporated treatment at the Altus location for the control of annual weeds while this treatment was not necessary at Stillwater.

Data collected consisted of visual ratings for hogpotato control which were taken approximately 3 weeks following herbicide application and continued throughout the growing season at approximately 3 week intervals.

Bioassay. Soil samples were collected on January 29,1988 from plots in the two field studies conducted at Stillwater. A total of 40 cores 1.9 cm in diameter and 15.2 cm deep were randomly removed from each plot, screened to pass a 5 mesh sieve, and air dried.

Separate bioassays were performed for each field study at Stillwater. From each plot sample, 200 g of soil was removed and placed in 295 ml cups and 8 cotton, 10 grain sorghum, or 12 wheat seeds were evenly spaced on the soil surface and then covered with an additional 100 g of soil to give a planting depth of 1.9 cm. For each study, cups were arranged in a randomized complete block design with four replications. Within each replication, cups having the same crop were arranged in a single row and rows were randomized. Cups, each having four holes near the bottom, were placed into separate watering dishes and sub-irrigated with 100 mls of distilled water. Cups were then placed under continuous light provided by florescent lamps and a constant temperature of 31 C was maintained. Following germination, plants were sub-irrigated at 2 day intervals with 50 mls of distilled water. One week after planting, cotton, grain sorghum, and wheat were hand-thinned to 4, 4, and 6 plants/cup, respectively. All above-ground plant herbage was harvested 21 days after planting and fresh weights taken. Plants were then oven dried at 40 C for 72 hours and reweighed.

Treatments, treatment dates, and visual rating dates varied by experiment; therefore, all experiments were analyzed separately. All data were subjected to analysis of variance and visual hogpotato control means were separated using a protected LSD test at the 0.05 level of probability while all other means were compared at the 0.10 level of probability.

RESULTS AND DISCUSSION

Field experiments. The best initial control was provided by glyphosate applied at a rate of 3.36 kg ai/ha in a 2% ammonium sulfate carrier solution and by dicamba applied at a rate of 0.56 kg ai/ha (Table 1). On August 18 (26 days after treatment), dicamba and glyphosate were providing hogpotato control of 72 and 79%, respectively. However, on September 4, 43 days after treatment, these treatments were providing weed control of less than 65%. Hogpotato control by imazapyr gradually increased as the growing season progressed. Late season ratings taken on October 12, (81 days after treatment) showed that imazapyr at rates of 0.84, 1.12, and 1.68 kg ai/ha was providing hogpotato control in excess of 90%. All other treatments resulted in significantly less hogpotato control which varied from 8 to 54%.

Results from herbicide applications made on August 6 at Stillwater indicated that tryclopyr at a rate of 2.24 kg ai/ha provided excellent hogpotato control as early as 18 days after treatment and continued to provide hogpotato control in excess of 85% for the remainder of the growing season (Table 2). Tebuthiuron at a rate of 3.36 kg ai/ha provided only 34% hogpotato control by October 26, 51 days after treatment; however, hogpotato control from tebuthiuron at both rates showed gradual improvement as the season progressed.

At Altus, early ratings taken on July 8 (20 days after treatment) indicated that glyphosate at rates of 3.36 and 2.24 kg ai/ha in a 2% ammonium sulfate carrier solution were the best treatments with 56 and 60% hogpotato control, respectively (Table 3). Hogpotato control by these treatments declined to unacceptable levels on each of the remaining rating dates in 1987. Hogpotato control by the imazapyr treatments increased as the growing season progressed with all three treatments providing in excess of 70% control on September 1 and October 13. As seen with glyphosate, the dicamba treatment provided better control early in the growing season but at no point provided acceptable hogpotato control.

Bioassay. Evaluation of plant fresh weights indicated that imazapyr applications made on July 23 were the only treatments which resulted in significant plant injury (Tables 4 and 5). Cotton fresh weights were more sensitive to imazapyr than either grain sorghum or wheat. Imazapyr at rates of 1.12 and 1.68 kg ai/ha caused significant cotton fresh weight (4 plants) reductions of 18 and 16%, respectively, when compared to the untreated check. Grain sorghum or wheat plant fresh weights were not reduced by imazapyr which caused a significant increase in grain sorghum fresh weight at a rate of 0.84 kg ai/ha. Dicamba at either rate (0.28 or 0.56) did not result in plant fresh weight reductions for any crop. For all crops, the 0.28 kg ai/ha rate of dicamba showed trends of increased plant biomass production and caused a significant increase in grain sorghum fresh weight when applied at this rate. The resulting increase in plant fresh weights caused by the lower rate of dicamba may be a result of the growth promoting properties (cell elongation, prolific tissue growth) which are possessed by the benzoic acid herbicide family. Researchers (9) have shown that sublethal rates of several herbicides in this family and specifically dicamba can cause increased plant biomass production; thus providing a possible explanation for the increase in fresh weights observed in plants growing in soil treated with the low rate of dicamba.

The effects of imazapyr and dicamba on plant dry weight were similar to those on fresh biomass (Tables 4 and 5). As seen with fresh weights, cotton was more sensitive to imazapyr than either grain sorghum or wheat. All rates of imazapyr resulted in significant reductions in cotton plant fresh weights which ranged from 16 to 27%. Wheat biomass was significantly reduced by 3 and 4 mg/6 plants by imazapyr at rates of 1.12 and 1.68 kg ai/ha, respectively, when compared to the untreated check. Dicamba did not cause dry biomass reductions at either rate for any crop, but as seen with plant fresh weights, trends indicated increased biomass production when applied at the low rate.

Soil bioassays from treatments applied at Stillwater on August 6, 1987 indicated that tebuthiuron caused significant fresh biomass reductions for all crops (Tables 6 and 7). Wheat and cotton shoot growth was extremely sensitive to tebuthiuron and suffered significant biomass reductions. Tebuthiuron at a rate of 3.36 kg ai/ha reduced wheat and cotton fresh weight by 83 and 93%, respectively. Tebuthiuron also caused significant reductions in grain sorghum fresh weights at the higher rate. Plant biomass production in the tryclopyr treatment was not different than the untreated check for any crop.

When oven dried, plant biomass showed similar trends as seen with plant fresh weights. Tebuthiuron at rates of 2.24 and 3.36 kg ai/ha caused significant reductions in dry biomass for all crops. The high rate of this herbicide reduced dry biomass by 36, 13, and 10 mg for cotton, grain sorghum and wheat, respectively.

Although significant above-ground biomass reductions resulted from several herbicides, their potential use for hogpotato control cannot be ignored. Given the growth habits of the weed (small, densely covered areas) and the potential yield reductions in these infested areas, producers may choose to sacrifice these small areas and use herbicides such as imazapyr or tebuthiuron to control the weed. This decision may not be as drastic as first appears when potential yield reductions as large as 99% are taken into account. Although crop production would likely be sacrificed for a minimum of one year, the weed problem could be brought under control or even eradicated.

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Table 1. Hogpotato control from herbicide applications made on July 23, 1987 at Stillwater. OK.

Treatment	Rate	Visual hogpotato control 8/18/87 (26 DAT)	9/4/87 (43 DAT)	10/12/87 (81 DAT)
	(kg ai/ha)		(%)	
Imazapyr	0.84	36	53	94
Imazapyr	1.12	33	54	93
Imazapyr	1.68	46	59	94
Dicamba	0.28	50	4	11
Dicamba	0.56	79	33	30
Glyphosate + ammonium sulfate	1.12 + 2% w/w	20	26	8
Glyphosate + ammonium sulfate	2.24 + 2% w/w	54	41	39
Glyphosate + ammonium sulfate	3.36 + 2% w/w	72	64	54
Untreated	---	0	0	0
LSD (0.05)	---	23	21	23

Table 2. Hogpotato contol from herbicide applications made on August 6, 1987 at Stillwater, OK.

		Visual hogpotato control		
Treatment	Rate	8/24/87 (18 DAT)	10/12/87 (67 DAT)	10/26/87 (81 DAT)
	(kg ai/ha)	-----------	(%)	-----------
Tebuthiuron	2.24	4	5	8
Tebuthiuron	3.36	6	29	34
Tryclopyr	2.24	91	86	87
Untreated	----	0	0	0
LSD (0.05)	----	8	15	13

Table 3. Hogpotato control from herbicide applications made on June 18, 1987 near Altus OK.

		Visual hogpotato control			
Treatment	Rate	7/8/87 (20 DAT)	7/30/87 (42 DAT)	9/1/87 (75 DAT)	10/13/87 (117 DAT)
	(kg ai/ha)	(%)			
Imazapyr	0.84	43	59	77	76
Imazapyr	1.12	34	50	71	75
Imazapyr	1.68	31	51	72	74
Dicamba	0.56	39	21	23	10
Glyphosate + ammonium sulfate	1.12 + 2% w/w	33	18	13	9
Glyphosate + ammonium sulfate	2.24 + 2% w/w	60	41	34	30
Glyphosate + ammonium sulfate	3.36 + 2% w/w	56	41	34	35
Untreated	---	0	0	0	0
LSD (0.05)	---	22	19	22	15

Table 4. Effects of herbicides on cotton, grain sorghum, and wheat fresh and dry weights when applied at Stillwater on July 23, 1987 and sampled January 29, 1988.

		Fresh weight			Dry weight		
Treatment	Rate	Cotton	Grain sorghum	Wheat	Cotton	Grain sorg.	Wheat
	(kg ai/ha)	(mg/4 plants)		(mg/6 plants)	(mg/4 plants)		(mg/6 plants)
Imazapyr	0.84	278	136	55	46	34	13
Imazapyr	1.12	231	119	51	40	27	12
Imazapyr	1.68	237	108	51	45	22	11
Dicamba	0.28	312	141	65	58	35	17
Dicamba	0.56	276	112	58	51	28	15
Untreated	---	283	109	56	55	27	15
LSD (0.10)	---	38	21	10	9	6	3

Table 5. Effects of herbicides on cotton, grain sorghum, and wheat fresh and dry weights when applied at Stillwater on July 23, 1987 and sampled January 29, 1988.

		Fresh weight			Dry weight		
Treatment	Rate	Cotton	Grain sorghum	Wheat	Cotton	Grain sorg.	Wheat
	(kg ai/ha)	-------------------- (% of untreated check) --------------------					
Imazapyr	0.84	98	124	98	84	126	87
Imazapyr	1.12	82	109	91	73	100	80
Imazapyr	1.68	84	99	91	82	81	73
Dicamba	0.28	110	129	116	105	130	113
Dicamba	0.56	98	103	104	93	104	100
Untreated	---	100	100	100	100	100	100
LSD (0.10)	---	13	19	18	16	22	20

Table 6. Effects of herbicides on cotton grain sorghum, and wheat fresh and dry weights when applied at Stillwater on August 6, 1987 and sampled on January 29, 1988.

		Fresh weight			Dry weight		
Treatment	Rate	Cotton	Grain sorghum	Wheat	Cotton	Grain sorg.	Wheat
	(kg ai/ha)	(mg/4 plants)		(mg/6 plants)	(mg/4 plants)		(mg/6 plants)
Tebuthiuron	2.24	93	92	17	22	18	5
Tebuthiuron	3.36	21	78	9	16	13	4
Tryclopyr	2.24	264	129	58	51	32	14
Untreated	----	282	111	54	52	26	14
LSD (0.10)	----	72	22	18	11	7	3

Table 7. Effects of herbicides on cotton grain sorghum, and wheat fresh and dry weights when applied at Stillwater on August 6, 1987 and sampled on January 29, 1988.

Treatment	Rate	Fresh weight			Dry weight		
		Cotton	Grain sorghum	Wheat	Cotton	Grain sorg.	Wheat
	(kg ai/ha)	------------------- (% of untreated check) -------------------					
Tebuthiuron	2.24	22	83	31	42	69	36
Tebuthiuron	3.36	7	70	17	31	50	29
Tryclopyr	2.24	94	116	107	98	123	100
Untreated	----	100	100	100	100	100	100
LSD (0.10)	----	26	20	33	21	27	21

VITA 2

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Candidate for the Degree of

Master of Science

Thesis: INTERFERENCE AND CONTROL OF HOGPOTATO (HOFFMANSEGGIA GLAUCA) IN COTTON (GOSSYPIUM HIRSUTUM)

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